QCC and SS in the Japanese Small and Mid-size Manufacturing

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Based on a survey,[1] the following analysis examines not only the extent to which quality control circles (QCC) and suggestions-systems (SS) as JIT-supporting elements[2] have penetrated the Japanese small and mid-size manufacturing but also their possible contribution to improvement, i.e., the relationship between QCC, SS and improvement. In addition, it deals with matters relating to improvements architects, the number of suggestions a company may get per year and the amount of money suggestions for improvement may be worth. After the presentation of the survey data, the conclusion tries to shed the light on the trend of the penetration of QCC and SS in the small and mid-size manufacturing, on the relation between QCC, SS and improvement; and on the financial advantage that may result from setting up QCC and SS in a company.

key words : QCC, SS, improvement, IC,Japanese small and mid-size manufacturing

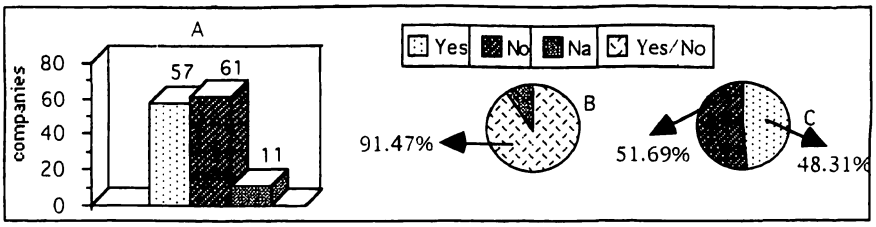

Figure 1 Do you have QCC?

1. Does your company have QCC?

Does your company have QCC? 118 of a total of 129 companies covered by the survey replied positively or negatively to the question. That represents 91.47% of the companies (see **Figure 1 A & B**). Among that large majority (91.47%), a large minority of 48.31% said they do use QCC (see **Figure 1 A & C**). Though 57 companies were identified as possessing QCC, 54 clearly state to. To that number were added three others obtained by deduction as the latter did not mention to have QCC: two of them specified that QCC activities concern both their office and line workers while the third one specified that QCC activities were conducted by office workers only.

Careful attention was paid to that large minority possessing QCC in order to deal with the following questions: 1) Who takes part in QCC? 2) Are QCC activities conducted after work? 3) Can QCC activities be considered overtime 4) How long does a QCC meeting last?

1.1. Who takes part in QCC activities?

87.72% of the 57 QCC companies (i.e. those that have QCC) gave details as to who is involved in such activities. In 37 companies, QCC involves everyone, that is what in Japan is referred to as total quality control (TQC) or company wide quality control (CWQC).[3] Six companies mentioned office workers as those concerned by QCC while four companies said those activities are reserved for line workers. For three companies, QCC is a matter of office and line workers. The distribution of those involved in QCC is shown in **Figure 2.**

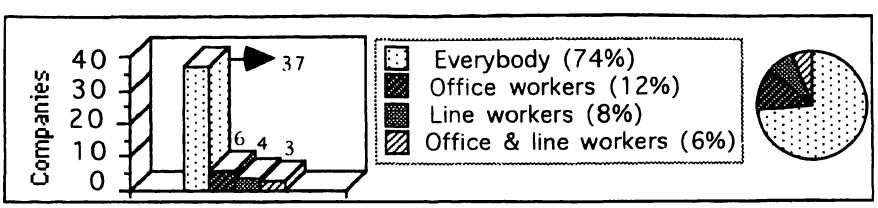

Figure 2 Who takes part in QCC activities?

1.2. Are QCC activities conducted after work?

Are QCC activities conducted after work? Among the 57 QCC companies, 25 said yes, seven did not pay any attention to that question while the other 25 replied negatively. Among the respondents, the average number of companies conducting such activities during working hours is therefore 50%.

This reminds me of Daikin, a major air-conditioning manufacturing company where production operators stop working for a half hour and devote that time to QCC activities.[4)]

1.3. QCC activities as overtime

If QCC activities take place after work, is the time devoted to them considered overtime (and duly paid)?

Of the 57 companies with QCC, 22 (or 38.6%) *would* consider QCC activities done after work as overtime while nine (15.79%) said they would not. The remainder, i.e., 26 enterprises (45.6%), did not deal with that question (**Figure 3**).

Among the 25 firms which as a matter of fact hold QCC meetings after work time, five (20%) recognize them as overtime work, seven (28%) do not and 13 of them (52%) avoided giving any replies.

As for the other 25 businesses that do not have such activities during working hours, 56% would consider them overtime would the activities take place after work.

1.4. QCC activities frequency and duration

As to the frequency of QCC activities, almost they are held on a weekly basis. 27 companies out of the 54 that specifically stated to hold QCC activities indicated the time a QCC meeting lasts. The QCC meeting time ranges from 10 to 150 minutes. Many

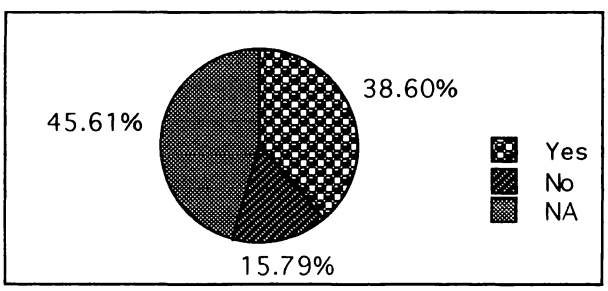

Figure 3 Do you recognize QCC activities held after work as overtime?

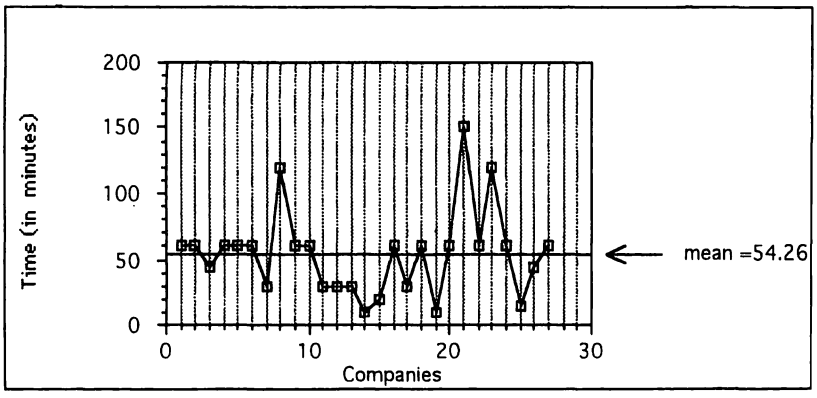

Figure 4 Distribution of minimum time for a QCC meeting

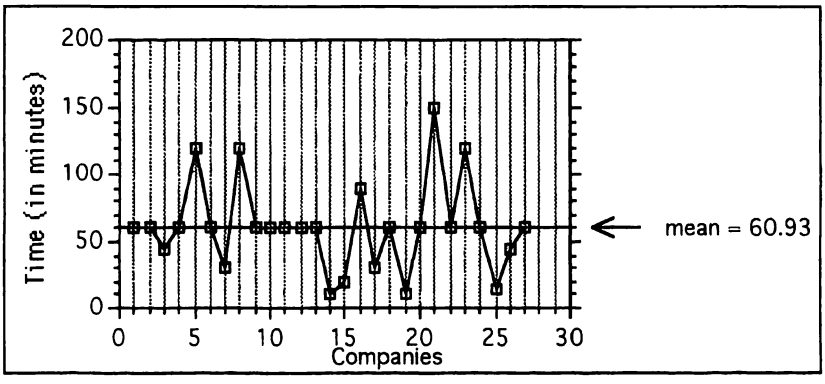

Figure 5 Distribution of maximum time for a QCC meeting

companies indicated both the minimal and maximal time devoted to QCC. The minimal average time for QCC meetings is 54.259 minutes while for the maximal time, the average stands at 60.926 minutes (**Figures 4 and 5**).

The mode for both the minimum and maximum is 60 minutes. Let me recall the statistical definition of the mode. It is "the value in a frequency distribution which occurs most frequently".[5] The total cumulative time devoted to QCC activities ranges from 1465 minutes to 1656 minutes a week (i.e., from 24 hours to 27 hours).

The percentage of companies whose minimal time for QCC activities is equal to or less than 60 minutes is 88.889%, i.e., 24 companies while 22 companies or 79.481% devote a maximal time not exceeding 60 minutes.

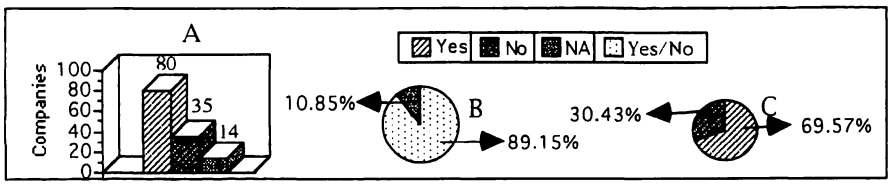

Figure 6 Do you have the suggestion system?

2. Does your company use SS?

Does your company use SS? 89.15% of the 129 companies covered by the survey replied positively or negatively to the question (see **Figure 6 A & B**).

Among that large majority (89.15%), a majority representing 69.57% of the respondents said they do use SS (**Figure 6 C**).

The following lines will focus on those 69.57%, i.e., 80 companies out of 115.

2.1. Number of suggestion per company per year

Among the 80 companies that have SS (or SS companies), 49 or 61.25% indicated the number of suggestions they are getting per year.

The minimum and maximum number of suggestions range from one to 5000 and from two to 5000 respectively. In a word, the overall range of the number of suggestions goes from one to 5000. Their cumulating total varies from 11612 to 11698 with the average fluctuating thus between 236.98 and 238.735 suggestions. For both the maximum and minimum number of suggestions, the mode is situated at 20 suggestions with a frequency of 6 and 8 (companies) respectively. **Tables 1, 2 & 3** show the findings in details.

A close look at **Tables 1 & 2** shows that four companies whose suggestions are situated

Table 1 Minimal number of annual suggestions per company

Suggestions' range	Frequencies (Companies)	Frequencies in %	% Cumulating	Total Suggestions	Suggestions in %	% Cumulating
1−20	28	57.14	57.14	321	2.76	2.76
30−80	9	18.37	75.51	441	3.80	6.56
100−350	8	16.33	91.84	1,750	15.07	21.63
900	1	2.04	93.88	900	7.75	29.38
1500	1	2.04	95.92	1,500	12.92	42.30
1700	1	2.04	97.96	1,700	14.64	56.94
5000	1	2.04	100.00	5,000	43.06	100.00
Total	49	100.00		11,612	100.00	

Table 2 Maximal number of annual suggestions per company

Suggestions' range	Frequencies (Companies)	Frequencies in %	% Cumulating	Total Suggestions	Suggestions in %	% Cumulating
2−20	26	53.06	53.06	297	2.54	2.54
30−80	9	18.37	91.43	351	3.00	5.54
100−350	10	20.41	91.84	1,950	16.67	22.21
900	1	2.04	93.88	900	7.69	29.90
1500	1	2.04	95.92	1,500	12.82	42.72
1700	1	2.04	97.96	1,700	14.53	57.26
5000	1	2.04	100.00	5,000	42.74	100.00
Total	49	100.00		11,698	100.00	

Table 3 Summary of the number of suggestions

	Suggestion range		Mean	Sum	Mode (freq.)	No. of companies.
	from	to				
Minimum	1	5000	236.98	11612	20 (8)	49
Maximum	2	5000	238.735	11698	20 (6)	49

between 900 and 5000 a year are too far apart from all the others and seem quite out of the normal range of representation. In fact, the other 45 companies have the number of suggestions per year within 350 (including the latter).

That means that excluding the four companies and their too high number of suggestions would give a mean that reflects better the majority of companies. Besides, their suggestions sum of 9100 is many times larger than the total sum of the remaining 45 companies, which is between 2512 and 2598. Furthermore, the sum of those remaining 45 companies is even about half the value of 5000 suggestions collected in only one company. Not taking those extreme cases into consideration would yield the following means: 55 (2512／45) and 57 (2598／45) for the minimum and the maximum number of suggestions respectively.

I think that the mean that ranges from 55 to 57 suggestions per company per year is more representative.

2.2. Number of suggestions per individual per year

53 companies (see **Tables 4 & 5**) among the 80 (or 66.25%) that have suggestions systems indicated the average number of suggestions they were collecting per individual per year.

Table 4 Minimum individual suggestions per company

Suggestions' ranges	Frequencies (companies)	Frequencies in %
0.0−1.0	23	43.39
1.5−5.0	22	41.51
10.0−20.0	5	9.43
30.0	1	1.89
70.0	1	1.89
85.0	1	1.89
Total	53	100.00

Table 5 Maximum individual suggestions per company

Suggestions' ranges	Frequencies (companies)	Frequencies in %
0.1−1.0	19	35.85
1.5−5.0	26	49.05
10.0−20.0	5	9.43
30.0	1	1.89
70.0	1	1.89
85.0	1	1.89
Total	53	100.00

The number of individual suggestions ranges from zero to 85. The mode for the minimum individual number of suggestions is one with a frequency recurrence of eleven. The value two has the second highest frequency of ten. Concerning the maximum number of suggestions, the mode is two but with a frequency of eleven. In the second position, there are two values, that is one and three which have each a frequency of eight. Three companies get each on average thirty, seventy, eighty-five individual suggestions respectively. That seems to be so out of the normal range that they may be excluded in order to extrapolate the result. The bulk of companies have the number of suggestions per individual varying between zero and twenty (see **Tables 4 & 5**).

2.3. Yen value of suggestions

Those suggestions are worth some savings, of course. Of the 80 SS companies, 26 or 32.5% (see **Tables 6 & 7**) stated the amount of yen suggestions are worth.

The yen value of suggestions ranges from 1,000 yen (three companies) to 5,000,000 yen (one company). The average varies from 696,538 to 718,077 yen. All together, the total value for those suggestions ranges from 18,110,000 to 18,670,000 yen as one can see in **Tables**

Table 6 Minimum yen value of suggestions

Yen range	Frequencies (Companies)	Frequencies in %	Total Yen	Yen in %
1,000−6,000	9	34.62	30,000	0.17
10,000−50,000	5	19.23	140,000	0.77
100,000−200,000	8	30.77	940,000	5.19
1,000,000	2	7.69	2,000,000	11.04
5,000,000	1	3.85	5,000,000	27.61
10,000,000	1	3.85	10,000,000	55.21
Total	26	100.00	18,110,000	100.00

Table 7 Maximum yen value of suggestions

Yen range	Frequencies (Companies)	Frequencies in %	Total Yen	Yen in %
1,000−6,000	7	26.92	20,000	0.11
10,000−50,000	6	23.08	110,000	0.59
100,000−200,000	9	34.62	1,540,000	8.25
1,000,000	2	7.69	2,000,000	10.71
5,000,000	1	3.85	5,000,000	26.78
10,000,000	1	3.85	10,000,000	53.56
Total	26	100.00	18,670,000	100.00

Table 8 Summary of the yen value of suggestions

	Mean	Range of Yen value		Mode (*freq.)	Sum	Number of Companies.
		from	to			
Minimum	696,538	1,000	10,000,000	100,000 (6)	18,110,000	26
Maximum	718,077	1,000	10,000,000	100,000 (6)	18,670,000	26

*freq. stands for frequency which refers here to the number of companies

6, 7 and 8.

Values of 1,000,000 yen, 5,000,000 yen, and 10,000,000 yen of which the total frequency is four or 15.39% are so far from others that they can be omitted in order to find a more representative mean. In fact, out of a total ranging from 18,110,000 to 18,670,000 yen, the four companies' suggestions are worth 17,000,000 yen while the suggestions values of the remaining 22 (companies) give a sum ranging from 1,110,000 to 1,670,000. The average value of suggestions for the 22 remaining companies is to be situated between 50,455 (1,110,000／22) and 75,909 yen (1,670,000／22).

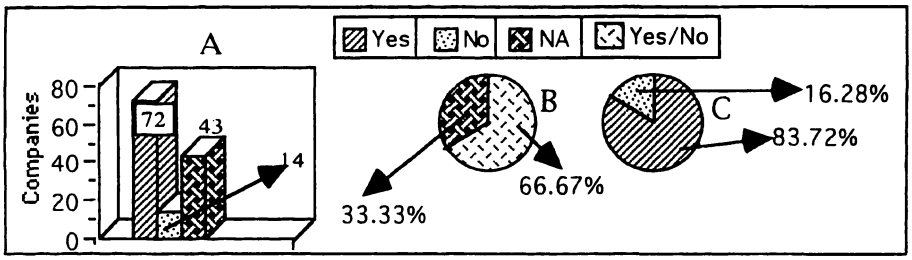

Figure 7 Have you made any improvement thanks to QCC/SS?

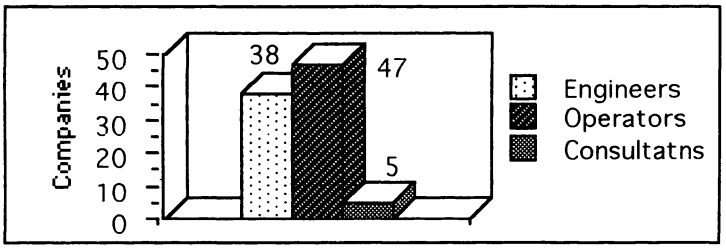

Figure 8 Contribution to improvement

3. Improvement

The questionnaire wanted to know whether some improvements were realized thanks to QCC and/or SS. 86 companies dealt with the question about improvement and the remaining 43 paid no attention to it. The number of respondents represents 66.67 % (**Figure 7 A & B**) among which 83.7% or 72 companies made some kind of improvement. 14 companies or 16.21% said no improvements were accomplished (**Figure 7 A & C**).

I will dig in the group of those 72 improvement companies (IC), i.e., companies with some kind of improvement to their credit, in order to know their authors. In fact, 67 IC out of 72 or 93.06% answered the question concerning the architects of improvement. The contribution to improvement has the following configuration. Engineers participated in 38, operators contributed in 47 and consultants in five companies as shown in **Figure 8**. That represents 56.71%; 70.15% and 7.46% respectively.

It is worth noting that the total frequencies (38+47+5) of 90 exceed the total of 67 IC which dealt with the question about improvement authors. The same holds also for the total of their percentages (56.71 + 70.15 + 7.46 = 134.32) that exceeds 100%.

The fact that the arithmetic summation fails to reflect correctly the reality means that no one is allowed to perform this operation at that stage of the analysis because doing so necessarily implies that some companies where more than one category of workers have

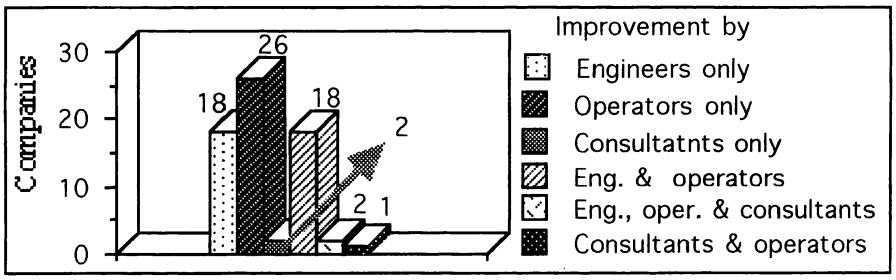

Figure 9 Improvement authors

been involved in improvement are counted twice or three times. In other words, the simple arithmetic operation, say the addition, does not hold here. On the contrary, applying the logical operation that corresponds to the arithmetic addition, i.e., the inclusive disjunction, would yield a total equal to the number of 67 IC. And the logical disjunctive operator "or" or "and/or" is well known to be equivalent to the math set theory's operation called the "union". Using math set theory as an analysis tool, one can realize that there should be - and there are - more classes of companies than initially identified. In fact, special classes called intersections whose elements usually belong to more than one group should be taken into account.

As matter of fact, a keen and detailed analysis of the survey findings leads to the following observations (**Figure 9**). Improvement was realized by engineers *only*, by line operators *only*, and by consultants *only* in 18, 26 and two companies respectively. That represents 26.87%; 38.81% and 2.98%. Eighteen other companies (26.87%) mentioned both engineers and line operators as improvement authors. In two enterprises (2.98%) only were improvement made by the three types of employees, i.e., engineers, line operators and consultants. Only a firm (1.49%) mentioned to have made some improvement thanks to both consultants and operations. At this level of a such detailed analysis, the arithmetic summation of all elements of different classes makes sense (see **Figure 9**).

4. Discussion and conclusive suggestions

Instead of being generalized, survey findings will be rather dealt with as indicators or symptoms that can help detect the extent of QCC and SS penetration in the small and mid-size manufacturing.[6] Besides, special attention will be paid to the relationship between improvement, QCC and SS. Where possible, lessons for companies outside Japan intending to switch to QCC and SS will be drawn from the experience of the Japanese small and mid-size manufacturing.

4.1. QCC

Of the 129 companies covered by the survey, 57 have QCC and 61 do not (**Figure 1**). As one can see it, the forces of changes toward QCC, i.e. JIT,[7] are almost equal to those of stagnation. If this tendency is real as the paper would like to suggest, it seems foreseeable that, in the future, most small and mid-size manufacturing enterprises will feature QCC.

37 companies out of 50 said QCC activities involve everyone (**Figure 2**). That reminds of Toyota where they are part of the duty of all workers, including management people. QCC activities are conducted after work (in 50% of the companies) or during work time.

A company trying to implement QCC outside Japan would better think of conducting such activities during the working hours. If conducted after work, such activities should be considered overtime as does the minority (38.6%) of surveyed companies (**Figure 3**).

No best suggestions could be made about the length of time for a QCC meeting: depending on the good the company is getting from QCC activities, both extremities of 10 and 150 minutes sound acceptable. If 10 minutes seem too short, the time may be extended and if 150 minutes look too long so that there is a lot of "waiting time" for ideas to come out, the time may be shortened. As to the frequency of QCC meetings, once a week may be a good thing as is the case for most of surveyed companies.

4.2. SS

The findings of the survey suggest that more and more companies of the small and mid-size manufacturing are heading for SS and that even most of them are already SS companies. In fact, the forces of resistance to becoming SS companies have been detected in a minority of about 30% among the enterprises covered by the survey (see **Figure 6**).

The number of suggestions per year ranges from one to 5000 though most companies (34 companies out of 49 or 69.4%) are getting 50 suggestions or less . The minimal number of one suggestion per year (in two companies, see **Table 1**) should be considered as the starting point which should not last for a long time. That is almost the zero level. The numbers 5000; 1500; 1700 and 900 suggestions, each with a frequency of one, which, I thought, would better be excluded in order to find a more representative mean should be regarded as showing the trends or the new orientations of companies that are succeeding in implementing JIT. In fact, big JIT-corporations are collecting millions of suggestions (see **Table 9**).

The least performing companies get less than one suggestion per individual while the three most performing ones have respectively 30, 70 and 85 suggestions per individual. The

Table 9 The ten most active kaizen programs in Japan, 1990

Company	Total suggestions	Ideas per person
1. Kawasaki Heavy	6,980,870	426.5
2. Nissan	6,043,344	126.9
3. Toshiba	4,166,864	76.4
4. Matsushita	4,114,398	43.7
5. Mazda	2,417,264	113.0
6. Toyota	2,003,646	35.0 [8]
7. Otu tire	1,475,707	1,185.3
8. Nihon Victor	1,247,523	83.1
9. Nissan Diesel	1,169,745	226.8
10. Fuji Heavy Ind.	998,359	88.1

Source: The Japan Human Relations Association, Summary of Japanese Suggestions Activities Survey, 1991. See S Alan G. Robinson & Dean M. Schroeder "Training, continuous improvement and human relations: the US TWI programs and the Japanese Style", *California Management Review,* Vol.35, no.2, Winter 1993, p.35-57

Table 10 Yen value of suggestions at Nissan Chemical and Canon

Period	Company	Investment in SS	cost savings (yield)
1978~82	Nissan Chemicals *	125,000	600,000 yen
1981; 1987	Nissan Chemicals *	160,000	630,000 yen
1983	Canon *	250,000	19,300,000 yen
1986	Toyota**	NA	230,000,000 US$

* Adapted from Imai, *Kaizen. The key to Japan's competitive success,* Singapore: McGraw-Hill, 1991, pp.107-120
** Adapted from K. Ohmae, *The mind of the strategist,* NY.:Penguin Books, 1983, p.207

company getting 85 suggestions is almost as good as some big JIT corporations that are among the ten-top leaders as regards the number of collected suggestions (see **Table 9**).

The company benefiting the most from suggestions earned 5,000,000 yen. Toyota - and probably all big JIT-corporations - with tens of thousands of workers and millions of suggestions earns hundreds of millions[9] (see **Table 10**). The amount of 5,000,000 yen was excluded in order to satisfy the requirements of the pure statistician who sticks to the meaningness of a representative mean. But in a field under change like the manufacturing sector facing the challenge of JIT, this big amount is full of meaning since it tells anyone wanting to implement JIT that suggestions are a source of revenues. The clear message is that a company can earn millions from the ideas of its work force.

Improvements in the JIT production environment are made through QCC and/or

Table 11 Total IC vs. QCC, SS and QCC/SS companies that are IC

Total Number of IC	72
1. −Number of QCC companies that are also IC −Percentage of IC that are QCC companies	51 70.8%
2. −Number of SS companies that are also IC −Percentage of IC that are SS companies	67 93%
3. −Number of QCC/SS companies that are also IC −Percentage of IC that are QCC/SS companies	47 65%

Table 12 IC within QCC, SS and QCC/SS companies

1. Total number of QCC companies 1.1. Number of QCC companies that are IC 1.2. % of QCC companies that are IC	**57** 51 89.5%
2. Total number of SS companies 2.1. Number of SS companies that are IC 2.2. % of SS companies that are IC	**88** 67 76.1%
3. Total number of QCC/SS companies 3.1. Number of QCC/SS companies that are IC 3.2. Percentage of QCC/SS companies that are IC	**49** 47 95.6%

suggestions systems. I am going to try to see whether in the field of small and mid-size manufacturing enterprises, there exists some kind of relationship between improvement, QCC and SS.

4.3. Improvement and QCC

It has been reported that 83.7% of companies are IC (**Figure 7 C**) and that 48.31% are QCC companies (**Figure 1 C**). Among the latter, 89.47% have made some improvements, i.e. are IC (**Table 12**). In other words, 70.8% of IC are QCC companies (**Table 11**).

4.4. Improvement and SS

69.57% of companies are SS companies, of which 83.75% have succeeded in becoming IC (**Table 12**). It means that 93.06% of IC are SS companies (**Table 11**).

4.5. Improvement, QCC & SS

There are 49 companies having both QCC and SS, which from now on will be also referred to as QCC/SS companies. In other words, 85.96% of QCC are SS companies and

Table 13 Relationship between QCC and SS companies

A. Total QCC／SS companies	49
B. －Total QCC companies －% of QCC that are SS companies *	57 85.96%
C. －Total SS companies －% of SS that are QCC companies **	90 61.25%

* (A／B)×100 ** (A／C)×100

61.25% of SS companies are also QCC companies (**Table 13**). 95.91% of QCC／SS companies are IC, i.e. companies that have experienced some kind of improvement (**Table 12**).

Tables 11, 12 and 13 suggest the following classification: a company may be of the type QCC, SS, or QCC／SS. A QCC／SS company is both of the type QCC and type SS. A careful analysis of data may lead to the following three observations. First there are more SS than QCC companies. Second, almost all QCC companies are also SS companies (85.96%). Third, about two thirds of SS companies (61.25%) are also of the type QCC. A QCC or an SS company is not necessary a QCC／SS one.

All and each of the three types aim at becoming IC. Data from the survey strongly suggest that companies featuring QCC, SS or both QCC & SS are very likely to make some improvement, i.e. to become IC. Is it possible to compare the degree of likelihood of making improvement between the three types of companies? This is a delicate issue to address since the path that leads to dealing with that matter seems slippery and may be misleading.

In fact, **Table 11** leaves the impression that among IC (1) the share of QCC／SS companies though being per se a majority is relatively the less important (65%); (2) QCC companies make a large majority (70%); (3) SS companies have the biggest share (93%). It would however be unfortunately misreading to conclude that the likelihood to make improvement (1) is the less high within companies featuring both QCC and SS; (2) is higher among companies that have switched to QCC only; is the highest for SS companies.

Table 11 compares cases of IC of each category with the total number of IC but not each group with the two others. Every group is considered independently, without any reference to others, with regard to the total number of IC only. *Therefore it would be difficult to draw for the moment any sound conclusion based on comparing QCC, SS and QCC／SS companies as regards the likelihood of making improvement.* Data concerning each group hold without any reference to others, and in that sense, can be said partial but independent.

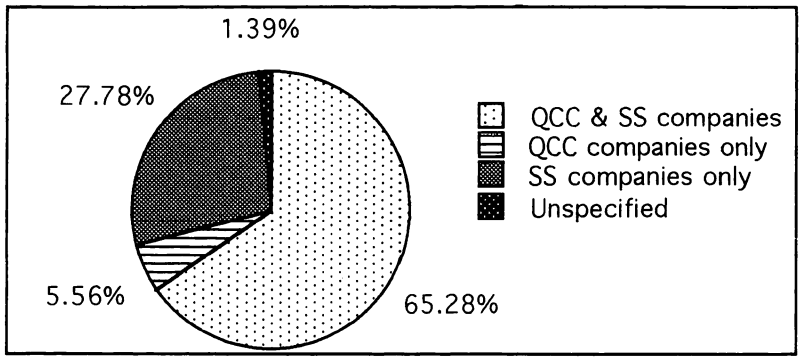

Figure 10 Distribution of IC with regard to QCC and/or SS

Based on these data, no sound correlation can easily be established between the groups.

Table 12 displays the results of digging in each category to see how many of its members made some improvement. At this level, the most revealing fact is that most QCC/SS companies credited themselves with improvement (95.6%). Furthermore, **Figure 10** which can be thought of as the integrated level of **Tables 11 & 12** reveals that the large majority of companies with improvement are those featuring both QCC and SS (65%). In other words, the probability of making some improvement seems the highest in companies featuring both QCC & SS. While **Table 12** shows that there are more IC among QCC companies (89.5%) than among SS ones (76%), **Figure 10** suggests that, when things are integrated, the likelihood for companies to turn IC is far higher in SS companies (27%) than in QCC enterprises (5.5%). But this may be due to the fact that, so far as the survey is concerned, there are numerically speaking more SS companies than QCC companies. Why are there more SS firms than QCC ones?

I think it may be so because SS are easier to carry out. What is needed is just to install suggestions boxes and to motivate people to suggest. SS require neither special structures nor special time. That may be also the first step to implement for a company outside Japan that wants to switch to continuous improvement. Introducing QCC can come next as the latter would probably need to be given more thought to: when should QCC activities take part? How long should QCC meeting last? etc. I think SS can be carried out without QCC but the latter should be always accompanied by the former. That explanation sheds the light on the fact that the number of SS companies that are also QCC companies is lower (61%) than that of QCC enterprises that feature also SS (85.96%).

Anyway, the most important thing to remember is that if a company carries out both SS and QCC programs, it has more chances of making improvements and even of sustaining

them because QCC and SS are permanent structures.

4.6. Improvement architects

One would have surely realized that the base of improvement seems to be the line workers. In fact, the majority of companies with improvement are those where line workers contributed.

Though I know from my experience of the JIT study that line workers are the real architects of improvement, I do not feel one can from the preceding facts confirm the same at this level of the present study. Does the quantitative superiority of IC where line workers participated (see **Figure 8**) mean that on the whole those cases of improvement are also qualitatively superior? If I have to keep my trust in JIT theories and practice, the importance of line workers cannot be neglected and is out of any doubt.[10] But for the case of the survey, one should not forget that the survey focused mainly on the number of companies that have made some kinds of improvement and not the nature or value of improvement itself which is much close to the field of industrial engineering and/or value engineering.

However, in order to get a glimpse of the real architects of improvement, let us try to find out whether there is *a correlation between improvements, their yen values, their authors and the number of companies in which they occurred.* The yen values of improvement were obtained indirectly by the yen values of suggestions because an improvement is a result of applying suggestions for improvement.

24 companies out of the only 26 that indicated the yen values of their suggestions (**Tables 6, 7 and 8**) will be considered because two companies whose total yen values vary from 150,000 to 200,000 yen will not be taken into account. In fact, one of the two did not answer the question about improvement while the other said it made no improvement though it indicated however the yen value of its suggestions.

As for the yen values of improvement, engineers contributed in 12 companies for a total amount varying between 16,243,000 and 16,653,000 yen, operators in 17 companies for a sum situated between 16,747,000 and 17,257,000 Yen. Consultants contributed to improvement in one company for a total of 30,000 Yen. As one sees, the total number of contribution and that of companies in which those improvement values are mentioned exceed the total number of amount of yen contribution and that of companies. That can be seen in comparing **Table 14** with **Tables 6, 7 & 8**. It means that a more detailed analysis of data is needed, groups should redefined and new ones constituted before one can perform the

Table 14 Total value of improvement by job category

Job category	companies	Range (in yen)	
		from	to
Engineers	12	16,243,000	16,653,000
Operators	17	16,747,000	17,257,000
Consultants	1	30,000	30,000
Others	1	100,000	100,000
Total	31	33,120,000	34,040,000

Table 15 Exclusive contribution by category of workers

Category of workers	companies	Range (in yen)	
		from	to
Engineers only	6	1,113,000	1,113,000
Operators only	10	1,587,000	1,687,000
Consultants only	0	0	0
Others	1	100,000	100,000
Both engineers & operators	6	15,130,000	15,540,000
Both operators & consultants	1	30,000	30,000
Total	24	17,960,000	18,470,000

addition of their elements.

Table 15 shows the detailed and exclusive contributions by each category of employees. In six companies, contribution to improvement was by engineers only and that represents an amount of 1,113,000 yen. In 10 companies, only operators did make improvements worth 1,587,000~1,687,000 yen. There is not a single case of improvement by consultants only. In the nine remaining companies, the contribution were by both operators & engineers or operators & consultants (see **Table 15**).

If one subtracts the three extreme values of 10,000,000, 5,000,000 and 1,000,000 yen the contribution by both operators and engineers falls to 130,000 yen and 540,000 yen respectively. But everybody knows that there is no need to do so because this indicates an orientation toward progress.

Numerically speaking, only consultants seem not to play an important role in improvement. In fact, it seems that the least involved people concerning improvements companies have realized are consultants. Is that due to the fact that, because of the lack of sufficient funds small companies usually suffer from, the small and mid-size manufacturing can hardly afford to hire consultants? Or does it mean that consultants do not really play any important role in improvements made at the work place? Both questions can

accept a yes- or a no-answer since both options are and remain possible because either is worth defending.

However, it would be wise, because there are no sufficient data, not to draw any firm conclusions about small and mid-size manufacturing concerning the real architects of improvement between engineers, line workers and consultants though **Table 14** suggests strongly the importance of those people who have their hands on the machine every day, i.e., line workers (over engineers who work in air-conditioned rooms or laboratories and over consultants who do not know the work place very well).

4.7. Summary

QCC, SS and improvement as JIT features are not absent in the Japanese small and mid-size manufacturing. On the contrary, their presence is strongly felt there, with the extent of SS penetration being seemingly far larger than that of QCC.

Improvement can be made without QCC or SS. However QCC and SS being by their nature and purpose permanent instances for improvement, it seems almost impossible to sustain continuous improvement without them. Besides, the paper has (1) suggested strongly that companies featuring both QCC and SS are the most likely to make improvement, i.e. they have a very high probability to turn IC; (2) seemed to justify two important JIT principles: (a) improvement activities are more effective when involving every one concerned with the company; and (b) the most valuable source of improvement is in all probabilities made up of those people who have their hands and mind on the machine/process every day, i.e., line workers.

1) Concerning the survey, please refer to L. Kupanhy, (a) "Japanese Management in the Small and Mid-size Manufacturing: a survey", *Keieikenkyu* (Osaka City University), Vol. 43, No. 3, 1992; (b) *Japanese Manufacturing Company: JIT production method and management strategies,* doctoral dissertation, Graduate School of Business Administration, Osaka City University, Nov. 1993, Ann Arbor, Mich.: UMI Dissertation Services, 1994; (c) "Does the Japanese small and mid-size manufacturing use JIT? − A survey-based study", *Osaka City University Business Review,* No. 5, 1994

2) This paper, though looking like a stand-alone one, may be read as complementary to "Does the Japanese Small and Mid-size Manufacturing Use JIT? − A Survey-based Study"

3) M. Imai, *Kaizen. The key Japan's competitive success,* 1991, notes that "TQC is often understood in the West as part of QC activities, and it has often been thought to be the job for quality control engineers. Given the danger that the name TQC might be misleading and might fail to clearly communicate the scope of Japanese-style TQC, the term company-wide quality control (CWQC) was coined as a more precise term to use in explaining Japanese

quality control to overseas observers", P.43

4) I visited two factories of that company in Sakai City, Osaka Prefecture (in 1990)

5) The Living Webster. Encyclopedic Dictionary of the English Language, Charles E, Tuttle Co., Tokyo, 1975

6) The paper tries to detect trends toward JIT among the small and mid-size manufacturing. Please refer also to L.Kupanhy, (a) *Japanese Manufacturing Company: JIT production method and management strategies,* and (b) "Does the Japanese small and mid-size manufacturing use JIT? – A survey-based study".

7) According to L. Kupanhy, QCC as well as SS are JIT elements. See L. Kupanhy, *Japanese Manufacturing Company: JIT production method and management strategies;* and "Does the Japanese small and mid-size manufacturing use JIT? -- A survey-based study"

8) It is curious to notice that there is a decline in suggestions at Toyota. In 1986, there were 2,650,000 suggestions in total averaging 48 suggestions per employee (Production at Toyota. -Our basic philosophy, Toyota TMC, without data), p.27

9) According to K. Ohmae, *The mind of the strategist,* N.Y.: Penguin Books, 1983, Toyota was getting suggestions worth $230 million, p. 207

10) See D. A. Garvin, "Quality on the line", *Harvard Business Review,* Sept./Oct. 1983, pp. 65-75; R. J. Schonberger, "Production workers bear major quality responsibility in Japanese industry", *Industrial Engineering,* December 1982, pp. 34-40